**Hillsdale Lake**
**1999 Water Quality Report**

1. **General**.

a. **Project location**. Hillsdale Lake is located at river mile 18.2 on Big Bull Creek, a tributary of the Marais des Cygnes River. The project watershed consists of 144 square miles in the rapidly growing Johnson, Miami, and Douglas counties of east central Kansas. The project is approximately 5 miles northwest of Paola, Kansas.

b. **Authorized project purposes**. Flood control, water supply, recreation, fish and wildlife, and water quality control are the authorized purposes of the project completed in 1982.

c. **Pertinent data**.

| Pools | Surface Elevation (ft. above m.s.l.) | Current Capacity (1,000 A.F.) | Surface Area (acres) | Shoreline (miles) |
|---|---|---|---|---|
| Flood Control | 931.0 | 83.6 | 7,410 | |
| Multipurpose | 917.0 | 74.3 | 4,580 | 51 |
| Inactive | | 9.0* | | |
| Total | | 157.9 | | |

Total Drainage Area: 144 sq. miles
Average Annual Inflow: 94,241 acre-feet

* Contained in multipurpose pool.

2. **Activities and studies of the year**.

The Water Quality Unit (PM-PR-W) continued its participation in the multi-agency, cooperative water quality study of the Big Bull Creek watershed in 1999. Other agencies involved in the long-term study include the Johnson County Environmental Department (JCED), the Environmental Protection Agency (EPA), the United States Geological Survey (USGS), the Consolidated Farm Services Agency (CFSA), the Natural Resources Conservation Service (NRCS), and the Kansas Department of Health and Environment (KDHE). A citizens group, the Lake Region Resource Conservation and Development Council, Inc. (RC&D), is also a major participant in the long-term study begun in 1993. The organizations have entered into a cooperative agreement to develop and carry out a watershed protection plan for Hillsdale Lake. The plan addresses the effects of nutrient, sediment, and pesticide loading on water quality and water uses in the reservoir, which is now experiencing accelerated eutrophication. The objectives include implementation of nonpoint source pollution control measures in the watershed, closer evaluation of point-source discharges, implementation of the best available technology to improve water quality conditions in the tributary streams, and, ultimately, maintenance of the existing trophic state of the reservoir. To date, more than $1 million has been spent on pollution control practices. The NRCS's Environmental Quality Incentive Program annually provides more than $80,000 for cost-sharing to implement the practices. As a result, there has been a 17% reduction in sediment entering the lake. It is estimated that a 30 % reduction will be required to achieve in-lake water quality goals of 0.04 mg/L total phosphorus and 12 ug/L chlorophyll a. To further meet the water quality goals, studies were initiated in 1999 to establish an in-lake water clarity (secchi depth) criterion and to develop strategies for allocation of the Total Maximum Daily Load (TMDL) for phosphorus between nonpoint and point sources.

The most significant funding of the watershed study is by the EPA Section 319 Nonpoint Source Pollution Control Grant (C9007405-98) Program of the Clean Water Act administered by KDHE. The remaining funding and services are being provided by the cooperating organizations. In 1999, PM-PR-W performed monthly reservoir sampling and certain associated analytical work. The unit also funded analytical costs of $3,000 not covered by the Section 319 Grant.

The PM-PR-W field work included profiling of temperature, DO, conductivity, oxidation reduction potential or redox, and pH; measurement of photic zone and secchi depth; and collection, pretreatment, and delivery of depth integrated photic zone and sub surface water samples. The unit performed analyses for chlorophyll a, turbidity, and suspended solids in its mobile and wet laboratories.

The JCED and USGS have the major responsibilities of establishing and monitoring the stream stations. The JCED is the lead laboratory in both the reservoir and stream analytical work. The JCED laboratory performed ammonia, nitrite, nitrate, and total kjeldahl nitrogen; total phosphorus; dissolved orthophosphorus; fecal coliform; and atrazine analyses. Other laboratories participating include the USGS, CMQA, and EPA.

## 3. **Existing Conditions**.

a. **Inflow**. Big and Little Bull creeks, Wade Branch, and Rock Creek were sampled 1-6 times per month during 1999. As in past years, total nitrogen (TN) levels exceeded the in-stream eutrophy criterion of 1.2 mg/L during almost all survey periods (Table 1). Highest concentrations continue to be present in the larger streams with higher runoff and both point and nonpoint source contributions. Big Bull Creek at I-35 (HD-18) and Little Bull Creek at 207$^{th}$ Street (HD-22) had mean annual TN concentrations of 5.46 mg/L and 3.92 mg/L, respectively. The maximum TN concentration detected in 1999 surveys was 42.72 mg/L at HD- 23 (Big Bull Creek at 191$^{st}$ Street) on January 14. The smaller streams with lower runoff and no point-source contributions had mean annual TN concentrations of 2.14 mg/L (Wade) and 1.74 mg/L (Rock).

Similarly, total phosphorus (TP) concentrations in the two larger streams exceeded the established in-stream criterion of 0.1 mg/L during most survey periods. The mean annual TP concentrations were 0.81 mg/L and 0.48 mg/L in Big and Little Bull creeks, respectively. The smaller streams had mean annual TP concentrations ranging from 0.12-0.14 mg/L. The excessive nutrient levels have been present throughout the 7-year study period and clearly demonstrate that the Big Bull Creek is the most important source of nutrients to the lake. In past comparisons of the closest stations downstream of the existing point sources with the more downstream stations on both Big and Little Bull creeks, the data clearly demonstrated the impact of the sewage treatment plant (STP) effluent on water quality. The upper stations exhibited substantially higher concentrations of nutrients, particularly in the winter months when, presumably, the effluent discharges from the STPs comprised a greater percentage of the base stream flows (i.e., there was minimal dilution of the effluent discharges).

The algal response to the eutrophic nutrient levels was not measured in 1999; however, past data show the hypereutrophic levels exist despite the continuing high turbidity and suspended solids within the inflow streams. Big Bull Creek exhibited mean and maximum chlorophyll a concentrations in 1996 of 15.2 ug/L and 87.6 ug/L, respectively. Similarly, Little Bull Creek had mean and maximum chlorophyll A concentrations of 14.3 ug/L and 68.8 ug/L, respectively.

Atrazine concentrations in the inflow streams in 1999 continued to exhibit seasonal highs in the late spring in association with post-application, spring-runoff events. Maximum concentrations in Big Bull Creek ranged from 11 ug/L to 32 ug/L in April surveys. During the remainder of the year, the herbicide levels were substantially lower and did not pose a significant water supply concern. Mean annual atrazine concentrations were 5.86 ug/L, 2.80 ug/L, 1.06 ug/L, and 0.39 ug/L in the Big and Little Bull creeks, Rock Creek, and Wade Branch, respectively. The long-term mean concentrations for all tributaries have not exceeded the MCL of 3 ug/L. In a majority of the streams, however, there was a continuing exceedence of the EPA criterion for the protection of aquatic life of 1 ug/L.

b. **Lake**. Hillsdale Lake exhibited a fairly normal seasonal thermal regime during 1999. The forebay (downlake) area of the impoundment, represented by station HD-3, developed limited stratification in April (Table 2). During May the downlake area continued to be well oxygenated throughout the 14-meter water column. The onset of more intense stratification was noted in June when DO concentrations in the deepest portions of the water column dropped below 1 mg/L. The lake was intensely stratified by mid July with a maximum thermal differential of 7.6 $^{o}$C. The intensely stratified reservoir exhibited essentially anaerobic conditions in the lower half of the water column through August. Within the epilimnion, DO concentrations remained at or near saturation during July and August probably as a result of algal photosynthesis. By mid September, destratification had already occurred and the lake was again fairly well oxygenated throughout the water column. Historically, thermal stratification breaks down in mid to late September, and satisfactory DO concentrations redevelop throughout the water column. Steadily dropping water temperatures and increasing DO concentrations throughout the water column characterize the totally mixed forebay during the remainder of the year.

The middle portions the Big Bull arm (HD-6) and the Little Bull arm (HD-11) exhibited the same seasonal onset of stratification, but developed their maximum temperature differential between surface and bottom waters more quickly. Unlike the downlake area, the shallower, middle sections of the reservoir did not continue to be as strongly stratified during the remainder of the summer. Temperature differentials of only 1-2 $^{0}$C were present through August. Dissolved oxygen concentrations paralleled those downlake with the exception that anoxic conditions existed for shorter periods of time in the arms. Destratification typically occurs two weeks earlier in the arms than in the forebay, but in 1999 the entire lake exhibited isothermal conditions by mid September. Typically during this period, surface dissolved oxygen concentrations fall well below saturation as mixing occurs throughout the water column. And, as observed in 1999, oxygen conditions recover more quickly in the middle sections. The reoxygenation process is complete throughout the entire lake by late September.

Elevated nutrient levels were again present in the impoundment in 1999 (Table 3). As in 1998, the lake's mean total phosphorus (TP) concentration in surface waters was 0.06 mg/L. Also, as in previous years, the criterion of a maximum of 0.04 mg/L TP in the surface waters was met in the forebay but not in the arms. Total phosphorus concentrations were again highest in the Big Bull arm with a mean concentration of 0.08 mg/L for the 1999 survey period. The surface waters of the Little Bull arm had a 1999 mean TP concentration of 0.06 mg/L.

The calculated total nitrogen (TN) concentrations comprised of NH3, NO2, NO3, and TKN were similar to those present in past years, exhibiting their highest concentrations in the spring runoff period and in bottom waters where availability for algal uptake is limited. Mean 1999 TN concentrations in the surface waters of the forebay, Little Bull, and Big Bull arms were 1.29 mg/L, 1.25 mg/L, and 1.43 mg/L, respectively, which indicate moderately enriched conditions throughout the lake.

Water clarity generally increased from spring lows to mid summer highs. The downlake area exhibited the highest water clarity with mean and maximum photic zone depths of 2.14 m and 3.05 m, respectively, in 1999. The Big Bull arm exhibited the lowest water clarity with mean and maximum photic zone depths of 1.11 m and 1.71 m, respectively. The Little Bull arm clarity lay in between with mean and maximum photic zone depths of 1.45 m and 2.07 m, respectively. The mean turbidity and suspended solids associated with the above water clarities were as follows: downlake, 12 NTU and 7.6 mg/L; Big Bull arm, 26 NTU and 19 mg/L; and Little Bull arm, 16 NTU and 12 mg/L, respectively. These mean annual values reflect clear to moderately clear conditions in the downlake and arms, respectively, following fairly high turbidity in the early season runoff period.

Algal productivity under the above conditions was moderately high, ranging from mesotrophic during high turbidity periods to hypereutrophic during low turbidity periods. The mean and maximum chlorophyll concentrations were forebay, 6.5 ug/L and 9.8 ug/L; Big Bull arm, 16.0 ug/L and 34.6 ug/L; and Little Bull arm, 8.1 ug/L and 14.1 ug/l, respectively. The maximums present in the arms represented algal blooms, which caused taste and odor problems in finished drinking water supplies. However, combining the values for all stations produced a 1999 mean growing-season chlorophyll concentration of 10.2 ug/L, which met the eutrophy criterion established for Hillsdale Lake of 12 ug/L.

The 1999 herbicide levels continued to fall below the established criterion. Atrazine was detected throughout the survey period, but there was only one exceedence of the 3 ug/L MCL for drinking water supplies. The mean and maximum surface concentrations for the forebay, Little Bull and Big Bull arms were 1.6 ug/L and 2.1 ug/L; 1.7 ug/L and 2.3 ug/L; and 2.4 ug/L and 4.2 ug/L, respectively.

c. **Outflow**. Ambient conditions in the outlet during 1999 sampling periods were very satisfactory, continuing the trend observed throughout the period of record. The DO concentrations exceeded the minimum state standard, and temperature, pH, conductivity, and redox fell within acceptable ranges at all times (Table 4). With the exception of July, turbidity levels were moderately low with mean and maximum of 23 NTU and 69 NTU, respectively (Table 5). Suspended solids were also moderately low (mean and maximum of 20 mg/L and 69 mg/L, respectively). The 1999 mean TN concentration (1.44 mg/L) was slightly higher than the stream eutrophy criterion of 1.20 mg/L. The July total ammonia concentration (0.20 mg/L) was elevated, but did not exceed the chronic criterion for a warm water fishery. Nitrite concentrations were below the detection limit during many periods. Nitrate concentrations (mean and maximum of 0.83 mg/L and 1.70 mg/L, respectively) were acceptable for drinking water supplies. Total phosphorus concentrations (mean and maximum of 0.07 mg/L and 0.18 mg/L, respectively) fell below the in-stream eutrophy criterion of 0.10 mg/L in all but one sampling period. Atrazine concentrations continued to fall below the MCL for drinking water supplies with a mean and maximum of 1.50 ug/L and 2.00 ug/L, respectively, during 1999. However, these concentrations do represent an almost continuous exceedence of the criterion for the protection of aquatic life in the stream (1 ug/L).

4. **Future conditions**.

The overall water quality of Hillsdale Lake is satisfactory as evidenced by the continued good sport fishery. The extremely high suspended solids load entering the lake during storm events will ultimately cause excessive sedimentation in the upper portion of the pool, sharply reducing its size and flood storage capacity. The associated turbidity in the headwaters adversely affects the sport fishery and, therefore, the recreation benefits of the project. Eutrophic conditions in the inflow streams, which are attributable to point- and nonpoint source pollution, will ultimately impact the headwaters of the impoundment resulting in oxygen depletion problems, algal blooms, and fish kills. Lake nutrient levels can be expected to remain in eutrophic ranges until nonpoint source pollution control practices have been implemented on additional acreage within the watershed and point-source contributions are diverted or reduced. Pesticide surveys continue to show heavy herbicide loading in the streams in association with the spring and early summer storm runoff. And while atrazine levels in the lake have generally fallen below the MCL for drinking water supplies, they are still a concern, since many rural water district treatment plants will be required to use more costly activated carbon filtration to significantly reduce herbicide concentrations in their finished water. (Rural Water District No.2 in Miami County completed upgrades to its treatment system in 1999 at a cost of $3.3 million.) Finally, atrazine concentrations in the discharge will continue to be a concern until levels fall below the EPA criterion for the protection of aquatic life (1 ug/L).

5. **Recommendations**.

The District should continue to strongly support the cooperative, water quality monitoring and abatement program for the lake and the Big Bull watershed. The ultimate goal of the watershed protection program is to reduce the sediment and nutrient loading from the point and nonpoint sources to the Big and Little Bull Creeks. Continued support of the Osage River Basin modeling study should ultimately help to predict long-term, water quality conditions and to establish lake-specific, water quality criteria which will protect the aquatic ecosystems of each of the six Osage River Basin reservoirs.

Appendix
Tables 1-5.

Table 1. 1999 Water Quality Data for Big Bull Creek Watershed Streams

| STATION | | DEPTH | DATE | TN | TKN | NH3 | NO3-N | TP | DOP | ATZ | TSS | FC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DET LIMIT | | | | | | | | | | | | |
| REP LIMIT | | | | | 0.2 | 0.1 | 0.3 | 0.01 | 0.01 | 0.1 | | |
| UNITS | | m | mmddyy | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | ug/L | mg/L | /100ml |
| HD-18 | B.Bull I-35 | 0.1 | 1/14/99 | 15.13 | 6.07 | 5.22 | 3.84 | 1.21 | 1.12 | | 6 | 20 |
| HD-18 | | 0.1 | 2/17/99 | 4.32 | 0.89 | 0.19 | 3.24 | 0.39 | 0.28 | | 24 | 140 |
| HD-18 | | 0.1 | 3/8,9/99 | 8.34 | 3.67 | 0.7 | 3.97 | 0.66 | 0.27 | | 356 | |
| HD-18 | | 0.1 | 4/1/99 | 3.17 | 0.87 | | 2.3 | 0.42 | 0.26 | <0.1 | 28 | |
| HD-18 | | 0.1 | 4/14/99 | 3.57 | 1.37 | | 2.2 | 0.56 | 0.34 | 0.2 | 53 | |
| HD-18 | | 0.1 | 4/14,15/99 | 3.5 | 3.5 | | | 0.75 | 0.23 | | 608 | |
| HD-18 | | 0.1 | 4/16/99 | | | | | | | 32 | | |
| HD-18 | | 0.1 | 4/21/99 | | | | | | | 11 | | |
| HD-18 | | 0.1 | 4/22,23/99 | 8.89 | 5.39 | | 3.5 | 1.23 | 0.18 | | 1555 | |
| HD-18 | | 0.1 | 4/23/99 | | | | | | | 15 | | |
| HD-18 | | 0.1 | 4/26/99 | 6.15 | 2.65 | | 3.5 | 0.68 | 0.18 | | 698 | |
| HD-18 | | 0.1 | 5/4,5/99 | 5.04 | 3.34 | | 1.7 | 0.83 | 0.18 | | 984 | |
| HD-18 | | 0.1 | 5/13/99 | 3.88 | 0.78 | | 3.1 | 0.4 | 0.26 | | 50 | |
| HD-18 | | 0.1 | 5/17,18/99 | 6.83 | 3.43 | | 3.4 | 0.8 | 0.16 | | 768 | |
| HD-18 | | 0.1 | 5/27/99 | 4.37 | 1.47 | | 2.9 | 0.49 | 0.26 | | 90 | |
| HD-18 | | 0.1 | 6/28,29/99 | 7.75 | 5.75 | | 2 | 1.49 | 0.2 | | 1983 | |
| HD-18 | | 0.1 | 6/8/99 | 1.48 | 1.48 | | | 0.64 | 0.37 | 4 | 43 | |
| HD-18 | | 0.1 | 6/17/99 | | | | | | | 4 | | |
| HD-18 | | 0.1 | 6/23/99 | 4.9 | 1.2 | | 3.7 | 0.67 | 0.52 | | 59 | |
| HD-18 | | 0.1 | 6/24/99 | | | | | | | 3.7 | | |
| HD-18 | | 0.1 | 6/29/99 | | | | | | | 4.2 | | |
| HD-18 | | 0.1 | 7/7/99 | 4.35 | 1.55 | | 2.8 | 0.59 | 0.35 | | 65 | |
| HD-18 | | 0.1 | 7/9/99 | | | | | | | 3 | | |
| HD-18 | | 0.1 | 7/9,10/99 | 6.95 | 5.15 | | 1.8 | 1.32 | | | 1545 | |
| HD-18 | | 0.1 | 7/15/99 | | | | | | | 1.4 | | |
| HD-18 | | 0.1 | 7/21/99 | 5.3 | 1.3 | | 4 | 0.5 | 0.37 | 1.3 | 36 | |
| HD-18 | | 0.1 | 7/28/99 | | | | | | | 1.1 | | |
| HD-18 | | 0.1 | 8/6/99 | | | | | | | 1.1 | | |
| HD-18 | | 0.1 | 8/30/99 | 5.56 | 1.96 | | 3.6 | 1.1 | 0.93 | | 41 | |
| HD-18 | | 0.1 | 9/7,8/99 | 4.87 | 3.47 | | 1.4 | 1.37 | 0.59 | | 908 | |
| HD-18 | | 0.1 | 9/12/99 | 4.63 | 3.23 | | 1.4 | 1.12 | 0.39 | | 733 | |
| HD-18 | | 0.1 | 9/27,28/99 | 3.36 | 2.46 | | 0.9 | 0.83 | 0.42 | | 508 | |
| HD-18 | | 0.1 | 10/8/99 | 3.13 | 0.93 | | 2.2 | 0.47 | 0.32 | | 33 | |
| HD-19 | Rock Ck | 0.1 | 1/14/99 | 1.72 | 0.3 | 0.16 | 1.26 | 0.04 | 0.02 | | 3 | 30 |
| HD-19 | | 0.1 | 2/9/99 | 1.69 | 0.35 | <0.1 | 1.34 | 0.07 | 0.02 | | 16 | 320 |
| HD-19 | | 0.1 | 3/8/99 | 1.42 | 0.92 | <0.1 | 0.5 | 0.15 | 0.01 | | 160 | |
| HD-19 | | 0.1 | 4/1/99 | 0.87 | 0.47 | | 0.4 | 0.05 | <0.01 | <0.1 | 10 | |
| HD-19 | | 0.1 | 4/14/99 | | | | | | | <0.1 | | |

| STATION | | DEPTH | DATE | TN | TKN | NH3 | NO3-N | TP | DOP | ATZ | TSS | FC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DET LIMIT | | | | | | | | | | | | |
| REP LIMIT | | | | | 0.2 | 0.1 | 0.3 | 0.01 | 0.01 | 0.1 | | |
| UNITS | | m | mmddyy | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | ug/L | mg/L | /100ml |
| HD-19 | | 0.1 | 5/3/99 | 2.51 | 0.61 | | 1.9 | 0.11 | 0.04 | | 20 | |
| HD-19 | | 0.1 | 5/13/99 | 2.01 | 0.51 | | 1.5 | 0.1 | 0.03 | | 21 | |
| HD-19 | | 0.1 | 5/27/99 | 2.69 | 0.99 | | 1.7 | 0.19 | 0.06 | | 35 | |
| HD-19 | | 0.1 | 6/8/99 | | | | | | | 2.3 | | |
| HD-19 | | 0.1 | 6/14/99 | 1.79 | 0.79 | | 1 | 0.1 | 0.09 | | 23 | |
| HD-19 | | 0.1 | 6/23/99 | | | | | | | 1.6 | | |
| HD-19 | | 0.1 | 7/7/99 | 1.89 | 0.59 | | 1.3 | 0.17 | 0.05 | | 14 | |
| HD-19 | | 0.1 | 7/21/99 | | | | | | | 1.4 | | |
| HD-19 | | 0.1 | 7/28/99 | 1.11 | 0.71 | | 0.4 | 0.09 | 0.03 | | 19 | |
| HD-19 | | 0.1 | 10/8/99 | 1.42 | 0.72 | | 0.7 | 0.2 | 0.13 | | 11 | |
| HD-21 | Wade Ck | 0.1 | 1/14/99 | 1.34 | 0.15 | 0.15 | 1.04 | 0.03 | 0.02 | | 2 | 130 |
| HD-21 | | 0.1 | 2/9/99 | 2.49 | 0.89 | <0.1 | 1.6 | 0.15 | 0.05 | | 32 | 145 |
| HD-21 | | 0.1 | 3/8/99 | 9.86 | 5.64 | 0.9 | 3.32 | 0.88 | 0.31 | | 3270 | |
| HD-21 | | 0.1 | 4/1/99 | 0.62 | 0.22 | | 0.4 | 0.03 | <0.01 | <0.1 | 3 | |
| HD-21 | | 0.1 | 4/14/99 | | | | | | | 0.2 | | |
| HD-21 | | 0.1 | 4/21/99 | | | | | | | <0.1 | | |
| HD-21 | | 0.1 | 5/3/99 | 1.84 | 0.24 | | 1.6 | 0.05 | 0.03 | | 5 | |
| HD-21 | | 0.1 | 5/13/99 | 1.64 | 0.44 | | 1.2 | 0.04 | 0.03 | | 7 | |
| HD-21 | | 0.1 | 5/27/99 | 1.81 | 0.31 | | 1.5 | 0.07 | 0.04 | | 6 | |
| HD-21 | | 0.1 | 6/8/99 | | | | | | | 1.3 | | |
| HD-21 | | 0.1 | 6/14/99 | 1.25 | 0.25 | | 1 | 0.05 | 0.03 | | 9 | |
| HD-21 | | 0.1 | 6/17/99 | | | | | | | 0.6 | | |
| HD-21 | | 0.1 | 6/24/99 | | | | | | | 0.6 | | |
| HD-21 | | 0.1 | 7/7/99 | 1.21 | 0.21 | | 1 | 0.06 | 0.05 | | 2 | |
| HD-21 | | 0.1 | 7/15/99 | | | | | | | 0.2 | | |
| HD-21 | | 0.1 | 7/28/99 | 0.63 | 0.33 | | 0.3 | 0.13 | 0.03 | 0.2 | 7 | |
| HD-21 | | 0.1 | 10/8/99 | 0.88 | 0.28 | | 0.6 | 0.1 | 0.06 | | 4 | |
| HD-22 | L. Bull 207 | 0.1 | 2/9/99 | 2.49 | 0.51 | <0.1 | 1.98 | 0.11 | 0.04 | | 26 | 120 |
| HD-22 | | 0.1 | 3/8,9/99 | 5.41 | 3.48 | 0.2 | 1.73 | 0.7 | 0.07 | | 980 | |
| HD-22 | | 0.1 | 4/1/99 | 2.01 | 0.61 | | 1.4 | 0.05 | <0.01 | <0.1 | 6 | |
| HD-22 | | 0.1 | 4/14/99 | 3.39 | 1.49 | | 1.9 | 0.22 | 0.06 | | 45 | |
| HD-22 | | 0.1 | 4/14,15/99 | 2.96 | 2.96 | | | 0.7 | 0.11 | | 960 | |
| HD-22 | | 0.1 | 4/16/99 | | | | | | | 10 | | |
| HD-22 | | 0.1 | 4/22,23/99 | 6.98 | 4.38 | | 2.6 | 1.13 | 0.07 | | 1828 | |
| HD-22 | | 0.1 | 4/23/99 | | | | | | | 3.3 | | |
| HD-22 | | 0.1 | 4/26/99 | 5.26 | 2.76 | | 2.5 | 0.67 | 0.06 | | 1117 | |
| HD-22 | | 0.1 | 5/4,5/99 | 4.25 | 2.45 | | 1.8 | 0.76 | 0.09 | | 1368 | |
| HD-22 | | 0.1 | 5/13/99 | 3.13 | 0.43 | | 2.7 | 0.08 | 0.06 | | 23 | |
| HD-22 | | 0.1 | 5/17,18/99 | 7.22 | 3.92 | | 3.3 | 0.85 | 0.06 | | 1365 | |
| HD-22 | | 0.1 | 5/27/99 | 2.47 | 0.67 | | 1.8 | 0.21 | 0.04 | | 34 | |

| STATION | | DEPTH | DATE | TN | TKN | NH3 | NO3-N | TP | DOP | ATZ | TSS | FC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DET LIMIT | | | | | | | | | | | | |
| REP LIMIT | | | | | 0.2 | 0.1 | 0.3 | 0.01 | 0.01 | 0.1 | | |
| UNITS | | m | mmddyy | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | ug/L | mg/L | /100ml |
| HD-22 | | 0.1 | 6/8/99 | 0.87 | 0.87 | | | 0.18 | 0.07 | | 56 | |
| HD-22 | | 0.1 | 6/14/99 | | | | | | | 2.2 | | |
| HD-22 | | 0.1 | 6/23/99 | 2.46 | 0.66 | | 1.8 | 0.23 | 0.06 | | 37 | |
| HD-22 | | 0.1 | 6/28,29/99 | 7.7 | 5 | | 2.7 | 1.18 | 0.11 | | 1990 | |
| HD-22 | | 0.1 | 6/29/99 | | | | | | | 2.5 | | |
| HD-22 | | 0.1 | 7/7/99 | 2.71 | 0.71 | | 2 | 0.14 | 0.04 | | 46 | |
| HD-22 | | 0.1 | 7/9/99 | | | | | | | 0.9 | | |
| HD-22 | | 0.1 | 7/9,10/99 | 5.65 | 3.45 | | 2.2 | 0.9 | | | 1230 | |
| HD-22 | | 0.1 | 7/21/99 | 5.18 | 1.08 | | 4.1 | 0.09 | 0.06 | | 16 | |
| HD-22 | | 0.1 | 7/28/99 | | | | | | | 0.7 | | |
| HD-22 | | 0.1 | 8/30/99 | 2.28 | 0.88 | | 1.4 | 0.19 | 0.06 | | 27 | |
| HD-22 | | 0.1 | 9/7,8/99 | 4.3 | 3.5 | | 0.8 | 0.82 | 0.07 | | 1040 | |
| HD-22 | | 0.1 | 9/12/99 | 4.16 | 3.26 | | 0.9 | 0.7 | 0.07 | | 868 | |
| HD-22 | | 0.1 | 10/8/99 | 1.51 | 0.61 | | 0.9 | 0.13 | 0.07 | | 12 | |
| HD-23 | B. Bull 191 | 0.1 | 1/14/99 | 42.72 | 21.43 | 17.92 | 3.37 | 3.35 | 3.16 | | 6 | 120 |
| HD-23 | | 0.1 | 2/17/99 | 12.85 | 2.55 | 2.11 | 8.19 | 1.3 | 1.22 | | 6 | 90 |
| HD-24 | L. Bull 183 | 0.1 | 2/9/99 | 5.88 | 1.53 | 0.48 | 3.87 | 0.34 | 0.2 | | 23 | 100 |

Table 2. 1999 Hillsdale Lake Ambient Profiles

| Station | Date<br>mm/dd/yyyy | Depth<br>m | Time<br>hhmm | Temp<br>$^{o}C$ | D.O.<br>mg/L | Spec. Cond.<br>u ohms | pH | Orp.<br>mV |
|---|---|---|---|---|---|---|---|---|
| HD-3 | 04/20/1999 | 0.1 | 0930 | 11.9 | 9.6 | | | |
| | | 1 | 0931 | 11.8 | 9.5 | | | |
| | | 2 | 0932 | 11.8 | 9.5 | | | |
| | | 3 | 0933 | 11.8 | 9.4 | | | |
| | | 4 | 0934 | 11.8 | 9.4 | | | |
| | | 5 | 0935 | 11.8 | 9.4 | | | |
| | | 6 | 0936 | 11.7 | 9.4 | | | |
| | | 7 | 0937 | 11.6 | 9.4 | | | |
| | | 8 | 0938 | 11.5 | 9.4 | | | |
| | | 9 | 0939 | 11.5 | 9.2 | | | |
| | | 10 | 0940 | 11.4 | 9.1 | | | |
| | | 11 | 0941 | 11.4 | 9 | | | |
| | | 12 | 0942 | 11.3 | 9 | | | |
| | | 13 | 0943 | 11.2 | 8.8 | | | |
| HD-3 | 05/17/1999 | 0.1 | 0930 | 17.2 | 8.5 | 295 | 7.8 | 389 |
| | | 1 | 0931 | 17.2 | 8.4 | 295 | 7.8 | 391 |
| | | 2 | 0932 | 17.2 | 8.4 | 296 | 7.8 | 392 |
| | | 3 | 0933 | 17.2 | 8.4 | 295 | 7.8 | 392 |
| | | 4 | 0934 | 17.2 | 8.4 | 295 | 7.8 | 393 |
| | | 5 | 0935 | 17.2 | 8.4 | 295 | 7.8 | 393 |
| | | 6 | 0936 | 17 | 8.4 | 295 | 7.8 | 394 |
| | | 7 | 0937 | 17 | 8.3 | 295 | 7.8 | 395 |
| | | 8 | 0938 | 16.9 | 8.3 | 295 | 7.8 | 395 |
| | | 9 | 0939 | 16.9 | 8.2 | 295 | 7.8 | 396 |
| | | 10 | 0940 | 16.8 | 8.1 | 296 | 7.8 | 397 |
| | | 11 | 0941 | 16.2 | 7.6 | 298 | 7.7 | 399 |
| | | 12 | 0942 | 15.7 | 7.2 | 300 | 7.6 | 403 |
| | | 13 | 0943 | 15.6 | 7.1 | 301 | 7.6 | 404 |
| | | 14 | 0944 | 15.4 | 7 | 302 | 7.6 | 404 |
| HD-3 | 06/21/1999 | 0.1 | 0900 | 22.7 | 7.1 | 288 | 8.2 | 327 |
| | | 1 | 0901 | 22.6 | 6.9 | 288 | 8.2 | 329 |
| | | 2 | 0902 | 22.5 | 6.6 | 288 | 8.2 | 333 |
| | | 3 | 0903 | 22.4 | 6.3 | 289 | 8.1 | 336 |
| | | 4 | 0904 | 22.3 | 6.4 | 289 | 8.1 | 336 |
| | | 5 | 0905 | 22.3 | 6.2 | 290 | 8.1 | 338 |
| | | 6 | 0906 | 22.2 | 6.1 | 290 | 8.1 | 339 |
| | | 7 | 0907 | 22.2 | 6 | 290 | 8 | 341 |
| | | 8 | 0908 | 22 | 4 | 291 | 7.7 | 350 |
| | | 9 | 0909 | 19.7 | 0.9 | 296 | 7.2 | 362 |
| | | 10 | 0910 | 18.9 | 0.9 | 295 | 7.2 | 364 |
| | | 11 | 0911 | 17.9 | 0.1 | 299 | 7.2 | 366 |
| | | 12 | 0912 | 17.4 | 0.1 | 308 | 7.2 | 367 |
| | | 13 | 0913 | 17.3 | 0.1 | 312 | 7.3 | 360 |

| Station | Date mm/dd/yy | Depth m | Time hhmm | Temp $^{o}C$ | D.O. mg/L | Spec. Cond. u ohms | pH | Orp. mV |
|---|---|---|---|---|---|---|---|---|
| HD-3 | 07/19/1999 | 0.1 | 0830 | 27.1 | 7.9 | 271 | 8.2 | 227 |
| | | 1 | 0831 | 27 | 7.9 | 273 | 8.2 | 229 |
| | | 2 | 0832 | 26.9 | 7.3 | 274 | 8.2 | 235 |
| | | 3 | 0833 | 26.7 | 6.5 | 275 | 8 | 242 |
| | | 4 | 0834 | 26.3 | 4.9 | 277 | 7.7 | 252 |
| | | 5 | 0835 | 26 | 3.5 | 278 | 7.5 | 259 |
| | | 6 | 0836 | 25.8 | 3.3 | 278 | 7.5 | 261 |
| | | 7 | 0837 | 25.7 | 3.1 | 278 | 7.5 | 263 |
| | | 8 | 0838 | 25.6 | 2.7 | 279 | 7.4 | 264 |
| | | 9 | 0839 | 25 | 0.9 | 289 | 7.3 | 269 |
| | | 10 | 0840 | 22.6 | 0.1 | 291 | 7.2 | 246 |
| | | 11 | 0841 | 21.4 | 0.1 | 298 | 7.2 | 225 |
| | | 12 | 0842 | 20.6 | 0.1 | 304 | 7.2 | 199 |
| | | 13 | 0843 | 19.5 | 0.1 | 318 | 7.2 | 153 |
| HD-3 | 08/25/1999 | 0.1 | 0930 | 26.2 | 7 | 268 | 8 | 411 |
| | | 1 | 0931 | 26.2 | 6.8 | 268 | 8 | 420 |
| | | 2 | 0932 | 26.2 | 6.6 | 268 | 8 | 427 |
| | | 3 | 0933 | 26.2 | 6.6 | 269 | 8 | 432 |
| | | 4 | 0934 | 26.2 | 6.6 | 269 | 8 | 435 |
| | | 5 | 0935 | 26.1 | 6.6 | 269 | 8 | 440 |
| | | 6 | 0936 | 26.1 | 6.2 | 269 | 7.9 | 444 |
| | | 7 | 0937 | 26 | 5.8 | 270 | 7.8 | 448 |
| | | 8 | 0938 | 26 | 5.1 | 271 | 7.7 | 453 |
| | | 9 | 0939 | 25.5 | 2.4 | 275 | 7.4 | 463 |
| | | 10 | 0940 | 25.1 | 0.4 | 281 | 7.3 | 470 |
| | | 11 | 0941 | 22.5 | 0.1 | 323 | 7.2 | 149 |
| | | 12 | 0942 | 21.2 | 0.1 | 344 | 7.2 | 90 |
| | | 12.5 | 0943 | 21 | 0.1 | 349 | 7.2 | 71 |
| HD-3 | 09/20/1999 | 0.1 | 0930 | 21.8 | 5.8 | 266 | 7.6 | 523 |
| | | 1 | 0931 | 21.8 | 5.7 | 267 | 7.6 | 524 |
| | | 2 | 0932 | 21.8 | 5.7 | 267 | 7.6 | 526 |
| | | 3 | 0933 | 21.8 | 5.7 | 267 | 7.6 | 528 |
| | | 4 | 0934 | 21.8 | 5.7 | 267 | 7.6 | 529 |
| | | 5 | 0935 | 21.8 | 5.7 | 267 | 7.6 | 530 |
| | | 6 | 0936 | 21.8 | 5.7 | 267 | 7.6 | 531 |
| | | 7 | 0937 | 21.8 | 5.8 | 267 | 7.6 | 533 |
| | | 8 | 0938 | 21.7 | 5.8 | 267 | 7.6 | 534 |
| | | 9 | 0939 | 21.7 | 5.8 | 267 | 7.6 | 534 |
| | | 10 | 0940 | 21.7 | 5.8 | 267 | 7.6 | 535 |
| | | 11 | 0941 | 21.7 | 5.8 | 267 | 7.6 | 535 |
| | | 12 | 0942 | 21.7 | 5.8 | 267 | 7.6 | 536 |
| | | 12.5 | 0943 | 21.6 | 5.8 | 267 | 7.6 | 520 |

| Station | Date | Depth | Time | Temp | D.O. | Spec. Cond. | pH | Orp. |
|---|---|---|---|---|---|---|---|---|
| | mm/dd/yyyy | m | hhmm | $^{o}C$ | mg/L | u ohms | | mV |
| HD-6 | 04/20/1999 | 0.1 | 1100 | 11.6 | 9.5 | | | |
| | | 1 | 1101 | 11.6 | 9.5 | | | |
| | | 2 | 1102 | 11.6 | 9.5 | | | |
| | | 3 | 1103 | 11.4 | 9.4 | | | |
| | | 4 | 1104 | 11.4 | 9.3 | | | |
| | | 5 | 1105 | 11.3 | 9.2 | | | |
| HD-6 | 05/17/1999 | 0.1 | 1145 | 18.4 | 8.1 | 282 | 7.8 | 409 |
| | | 1 | 1146 | 18.4 | 8.1 | 283 | 7.8 | 408 |
| | | 2 | 1147 | 18.4 | 8.1 | 283 | 7.8 | 409 |
| | | 3 | 1148 | 18.3 | 8.1 | 283 | 7.8 | 410 |
| | | 4 | 1149 | 18.3 | 8 | 284 | 7.8 | 410 |
| | | 5 | 1150 | 18.3 | 8 | 284 | 7.8 | 410 |
| | | 6 | 1151 | 18.3 | 8 | 285 | 7.8 | 410 |
| HD-6 | 06/21/1999 | 0.1 | 1030 | 23.7 | 8.1 | 289 | 8.4 | 317 |
| | | 1 | 1031 | 23.6 | 8 | 289 | 8.4 | 319 |
| | | 2 | 1032 | 23.5 | 7.9 | 290 | 8.4 | 320 |
| | | 3 | 1033 | 23.2 | 7.6 | 291 | 8.3 | 323 |
| | | 4 | 1034 | 21.7 | 4.8 | 305 | 7.7 | 338 |
| | | 5 | 1035 | 21.4 | 4.4 | 310 | 7.7 | 342 |
| HD-6 | 07/19/1999 | 0.1 | 1000 | 28.5 | 8.1 | 267 | 8.4 | 273 |
| | | 1 | 1001 | 28.4 | 7.9 | 268 | 8.4 | 271 |
| | | 2 | 1002 | 28.4 | 7.8 | 268 | 8.4 | 270 |
| | | 3 | 1003 | 28.3 | 6.9 | 273 | 8.2 | 273 |
| | | 4 | 1004 | 27.3 | 2.1 | 280 | 7.5 | 296 |
| | | 5 | 1005 | 26.7 | 0.3 | 286 | 7.3 | 300 |
| HD-6 | 08/25/1999 | 0.1 | 1130 | 27 | 7.4 | 270 | 8.2 | 382 |
| | | 1 | 1131 | 25.8 | 6.3 | 274 | 7.9 | 392 |
| | | 2 | 1132 | 25.7 | 6.2 | 274 | 7.9 | 399 |
| | | 3 | 1133 | 25.7 | 6.1 | 275 | 7.8 | 401 |
| | | 4 | 1134 | 25.7 | 5.7 | 275 | 7.8 | 405 |
| | | 5 | 1135 | 25.6 | 4.9 | 275 | 7.7 | 251 |
| HD-6 | 09/20/1999 | 0.1 | 1130 | 21.1 | 7.8 | 265 | 8.2 | 516 |
| | | 1 | 1131 | 21.2 | 7.7 | 266 | 8.2 | 516 |
| | | 2 | 1132 | 21.1 | 7.7 | 266 | 8.1 | 517 |
| | | 3 | 1133 | 21.1 | 7.7 | 266 | 8.1 | 517 |
| | | 4 | 1134 | 21.1 | 7.4 | 267 | 8.1 | 516 |
| | | 5 | 1135 | 21 | 7 | 268 | 8 | 504 |

| Station | Date | Depth | Time | Temp | D.O. | Spec. Cond. | pH | Orp. |
|---|---|---|---|---|---|---|---|---|
| | mm/dd/yyyy | m | hhmm | $^{o}C$ | mg/L | u ohms | | mV |
| HD-11 | 04/20/1999 | 0.1 | 1030 | 12.3 | 9.5 | | | |
| | | 1 | 1031 | 12.2 | 9.4 | | | |
| | | 2 | 1032 | 11.8 | 9.4 | | | |
| | | 3 | 1033 | 11.6 | 9.2 | | | |
| | | 4 | 1034 | 11.3 | 9.1 | | | |
| | | 5 | 1035 | 11.1 | 8.9 | | | |
| | | 6 | 1036 | 11.1 | 8.8 | | | |
| | | 7 | 1037 | 10.9 | 8.3 | | | |
| HD-11 | 05/17/1999 | 0.1 | 1045 | 18 | 7.7 | 303 | 7.7 | 407 |
| | | 1 | 1046 | 17.9 | 7.6 | 303 | 7.7 | 408 |
| | | 2 | 1047 | 17.9 | 7.7 | 302 | 7.7 | 408 |
| | | 3 | 1048 | 17.9 | 7.7 | 302 | 7.7 | 408 |
| | | 4 | 1049 | 17.9 | 7.5 | 302 | 7.7 | 409 |
| | | 5 | 1050 | 17.8 | 7.5 | 303 | 7.7 | 409 |
| | | 6 | 1051 | 17.7 | 7.4 | 303 | 7.7 | 409 |
| | | 7 | 1052 | 17.7 | 7.3 | 303 | 7.7 | 410 |
| | | 8 | 1053 | 17.2 | 6.5 | 307 | 7.6 | 413 |
| | | 9 | 1054 | 16.7 | 5.5 | 310 | 7.4 | 416 |
| HD-11 | 06/21/1999 | 0.1 | 0945 | 23.7 | 8.4 | 288 | 8.4 | 326 |
| | | 1 | 0946 | 23.3 | 7.7 | 295 | 8.3 | 330 |
| | | 2 | 0947 | 22.4 | 5.8 | 308 | 7.8 | 342 |
| | | 3 | 0948 | 22.3 | 5.7 | 310 | 7.8 | 345 |
| | | 4 | 0949 | 22.2 | 5.2 | 312 | 7.7 | 348 |
| | | 5 | 0950 | 22.1 | 4.6 | 312 | 7.7 | 351 |
| | | 6 | 0951 | 22 | 3.6 | 315 | 7.6 | 355 |
| | | 7 | 0952 | 21.9 | 2.4 | 320 | 7.5 | 358 |
| HD-11 | 07/19/1999 | 0.1 | 0915 | 28.2 | 8.2 | 268 | 8.5 | 225 |
| | | 1 | 0916 | 28 | 7.9 | 270 | 8.4 | 230 |
| | | 2 | 0917 | 27.8 | 6.6 | 278 | 8.2 | 240 |
| | | 3 | 0918 | 27.6 | 5.5 | 281 | 8 | 247 |
| | | 4 | 0919 | 27.1 | 4 | 284 | 7.7 | 255 |
| | | 5 | 0920 | 26.6 | 3 | 287 | 7.5 | 262 |
| | | 6 | 0921 | 26.4 | 1.6 | 289 | 7.4 | 265 |
| | | 7 | 0922 | 26.1 | 0.2 | 295 | 7.3 | 267 |
| HD-11 | 08/25/1999 | 0.1 | 1030 | 26.9 | 7.5 | 271 | 8.2 | 350 |
| | | 1 | 1031 | 26.4 | 6.8 | 272 | 8.1 | 359 |
| | | 2 | 1032 | 26.3 | 6.3 | 272 | 8 | 363 |
| | | 3 | 1033 | 26.1 | 4 | 274 | 7.6 | 367 |
| | | 4 | 1034 | 25.9 | 2 | 274 | 7.4 | 362 |
| | | 5 | 1035 | 25.9 | 1.6 | 275 | 7.3 | 357 |
| | | 6 | 1036 | 25.9 | 1 | 275 | 7.3 | 350 |
| | | 7 | 1037 | 25.8 | 0.5 | 277 | 7.2 | 285 |
| HD-11 | 09/20/1999 | 0.1 | 1030 | 21.3 | 6.8 | 269 | 7.8 | 533 |
| | | 1 | 1031 | 21.3 | 6.8 | 269 | 7.8 | 534 |
| | | 2 | 1032 | 21.3 | 6.7 | 269 | 7.8 | 535 |
| | | 3 | 1033 | 21.3 | 6.6 | 270 | 7.8 | 536 |
| | | 4 | 1034 | 21.2 | 6.4 | 271 | 7.7 | 537 |
| | | 5 | 1035 | 21.2 | 6.4 | 271 | 7.7 | 537 |
| | | 6 | 1036 | 21.2 | 6.4 | 271 | 7.7 | 537 |
| | | 6.5 | 1037 | 21.1 | 6.3 | 271 | 7.7 | 534 |

Table 3. 1999 Hillsdale Lake Water Quality Data

| STATION | DEPTH | DATE | TIME | TN | TKN | NH3 | NO3-N | NO2-N | TP | DOP | ATZ | Turbidity | TSS | Secchi | 1% | Chlor A ug/L |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DET LIMIT | | | | | | | | | | | | | | | | |
| REP LIMIT | | | | | 0.2 | 0.1 | 0.3 | 0.02 | 0.01 | 0.01 | 0.05 | | | | | |
| UNITS | m | mmddyy | hhmm | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | ug/L | NTU | mg/L | ft | ft | |
| HD-3 | 0.1 | 4/20/99 | 0930 | 1.56 | 0.63 | 0.1 | 0.8 | 0.03 | 0.06 | 0.02 | 0.4 | 23 | 11 | 1.6 | 4.4 | |
| | 0.1 | 5/17/99 | 0930 | 2.24 | 0.54 | <0.1 | 1.7 | <0.02 | 0.07 | 0.03 | 1.8 | 23 | 8.9 | 1.9 | 4 | 5.8 |
| | 0.1 | 6/21/99 | 0900 | 1.52 | 0.42 | <0.1 | 1.1 | <0.02 | 0.03 | <0.01 | 2.1 | 7.5 | 7.4 | 3.4 | 8.8 | 6.2 |
| | 0.1 | 7/19/99 | 0830 | 1.13 | 0.53 | <0.1 | 0.6 | <0.02 | 0.03 | <0.01 | 1.9 | 4.6 | 5.5 | 4.4 | 9 | 9.8 |
| | 0.1 | 8/25/99 | 0930 | 0.96 | 0.36 | <0.1 | 0.6 | <0.02 | 0.02 | <0.01 | 1.8 | 4.4 | 4 | 5 | 10 | 8.9 |
| | 0.1 | 9/20/99 | 0930 | 0.35 | 0.35 | <0.1 | <0.3 | <0.02 | 0.04 | 0.01 | 1.9 | 11 | 8.8 | 2.5 | 6 | 1.6 |
| HD-3 | 14 | 5/17/99 | 0944 | | 0.45 | <0.1 | 1.7 | <0.02 | 0.09 | 0.03 | | 30 | 14 | | | |
| HD-6 | 0.1 | 4/20/99 | 1100 | 2.35 | 0.92 | 0.1 | 1.3 | 0.03 | 0.13 | 0.04 | 4.2 | 47 | 25 | 0.9 | 2.4 | |
| | 0.1 | 5/17/99 | 1145 | 2.49 | 0.59 | <0.1 | 1.9 | <0.02 | 0.12 | 0.04 | 2.4 | 42 | 26 | 1 | | 4.7 |
| | 0.1 | 6/21/99 | 1030 | 1.45 | 0.55 | <0.1 | 0.9 | <0.02 | 0.05 | <0.01 | 2 | 14 | 9 | 2 | 5.6 | 14.9 |
| | 0.1 | 7/19/99 | 1000 | 1.06 | 0.56 | <0.1 | 0.5 | <0.02 | 0.06 | <0.01 | 1.9 | 14 | 16 | 2 | 4.5 | 34.6 |
| | 0.1 | 8/25/99 | 1130 | 0.82 | 0.42 | <0.1 | 0.4 | <0.02 | 0.07 | 0.01 | 2 | 18 | 18 | 1.6 | 3.8 | 11.6 |
| | 0.1 | 9/20/99 | 1130 | 0.39 | 0.39 | <0.1 | <0.3 | <0.02 | 0.06 | 0.01 | 1.6 | 20 | 21 | 1.5 | 3.5 | 14.3 |
| HD-6 | 6 | 5/17/99 | 1151 | | 0.54 | <0.1 | 1.8 | <0.02 | 0.12 | 0.04 | | 43 | 23 | | | |
| HD-11 | 0.1 | 4/20/99 | 1030 | 1.55 | 0.63 | 0.1 | 0.8 | 0.02 | 0.07 | 0.02 | 0.5 | 26 | 15 | 1.5 | 4 | |
| | 0.1 | 5/17/99 | 1045 | 2.30 | 0.58 | <0.1 | 1.7 | 0.02 | 0.09 | 0.04 | 1.3 | 29 | 11 | 1.3 | | 2.5 |
| | 0.1 | 6/21/99 | 0945 | 1.51 | 0.61 | <0.1 | 0.9 | <0.02 | 0.04 | <0.01 | 2.3 | 9.5 | 16 | 2.7 | 5.7 | 9.3 |
| | 0.1 | 7/19/99 | 0915 | 0.99 | 0.49 | <0.1 | 0.5 | <0.02 | 0.03 | <0.01 | 2.2 | 5.9 | 6.3 | 3.2 | 6.8 | 9.4 |
| | 0.1 | 8/25/99 | 1030 | 0.70 | 0.3 | <0.1 | 0.4 | <0.02 | 0.05 | <0.01 | 1.9 | 8.6 | 7.2 | 2.7 | 5.25 | 14.1 |
| | 0.1 | 9/20/99 | 1030 | 0.47 | 0.47 | <0.1 | <0.3 | <0.02 | 0.05 | <0.01 | 1.8 | 14 | 15 | 2 | 4.1 | 5.1 |
| HD-11 | 9 | 5/17/99 | 1054 | | 0.53 | <0.1 | 1.7 | 0.02 | 0.12 | 0.04 | | 44 | 28 | | | |

Table 4. 1999 Hillsdale Lake Outlet Ambient Data

| Station | Date | Depth | Time | Temp | D.O. | Spec. Cond. | pH | Orp. |
|---|---|---|---|---|---|---|---|---|
| | mmddyy | m | hhmm | $^{o}C$ | mg/L | u ohms | | mV |
| HD-2 | 4/20/99 | 0.1 | 1200 | 13.8 | 12.4 | | | |
| HD-2 | 5/17/99 | 0.1 | 1315 | 18 | 10.5 | 293 | 8.2 | 422 |
| HD-2 | 6/21/99 | 0.1 | 1115 | 22.4 | 8.8 | 290 | 8.1 | 318 |
| HD-2 | 7/19/99 | 0.1 | 1100 | 22.2 | 7.7 | 296 | 7.5 | 331 |
| HD-2 | 8/25/99 | 0.1 | 1300 | 27.2 | 9 | 265 | 8.3 | 388 |
| HD-2 | 9/20/99 | 0.1 | 1300 | 21.2 | 9.3 | 259 | 8 | 483 |

Table 5. 1999 Hillsdale Lake Outlet Water Quality Data

| STATION | DEPTH | DATE | TIME | TN | TKN | NH3 | NO3-N | NO2-N | TP | DOP | ATZ | Turbidity | TSS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DET LIMIT | | | | | | | | | | | | | |
| REP LIMIT | | | | | 0.2 | 0.1 | 0.3 | 0.02 | 0.01 | 0.01 | 0.05 | | |
| UNITS | m | mmddyy | hhmm | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | ug/L | NTU | mg/L |
| HD-2 | 0.1 | 4/20/99 | 1200 | 1.61 | 0.68 | 0.1 | 0.8 | 0.03 | 0.07 | 0.02 | 0.3 | 26 | 15 |
| | 0.1 | 5/17/99 | 1315 | 2.20 | 0.5 | <0.1 | 1.7 | <0.02 | 0.07 | 0.03 | 1.8 | 17 | 17 |
| | 0.1 | 6/21/99 | 1115 | 1.57 | 0.47 | <0.1 | 1.1 | <0.02 | 0.04 | <0.01 | 1.8 | 12 | 6.2 |
| | 0.1 | 7/19/99 | 1100 | 1.69 | 0.89 | 0.2 | 0.6 | <0.02 | 0.18 | 0.02 | 2 | 69 | 69 |
| | 0.1 | 8/25/99 | 1300 | 0.98 | 0.48 | <0.1 | 0.5 | <0.02 | 0.02 | <0.01 | 1.7 | 4.8 | 5.4 |
| | 0.1 | 9/20/99 | 1300 | 0.59 | 0.29 | <0.1 | 0.3 | <0.02 | 0.04 | 0.01 | 1.6 | 11 | 9.8 |